Amendment to the Specification

Please make the following corrections of typographical errors in the original specification of the above-referenced application. Applicant respectfully submits that the requested corrections, which were suggested by the Examiner in the office communication dated April 19, 2005, do not constitute new matter.

Amend the paragraph beginning at Page 1, line 5 as follows:

Typically a DSL network comprises a plurality of ~~Customer Premise Equipment~~ customer premise equipment (CPE) devices connected to a DSLAM (Digital Subscriber Line Access Multiplexer) via a bundle of twisted-pair wires. Fig. 1 illustrates such a prior art DSL network. The DSLAM is also connected to a network for sending and receiving data to and from the respective CPE. The DSLAM may further be connected to other devices, such as routers, for directing and switching data through the DSL network. A DSLAM comprises a plurality of DSL modems which may be implemented in software residing on one or more Digital Signals Processors (DSP). The ~~Customer Premise Equipment~~ customer premise equipment may include a variety of devices such as modems and handsets. By way of example the ~~Customer Premise Equipment~~ customer premise equipment of Fig. 1 comprise DSL modems capable of communicating with the DSLAM.

Amend the paragraph beginning at Page 1, line 16 as follows:

Each of the N CPE DSL modems of Fig. 1 are connected directly to a respective DSL modem in the DSLAM via a dedicated twisted-pair conductor, or POTS (Plain Old Telephone Service) line. The twisted-pair conductors are usually part of the ~~Public Switched Telephone Network~~ public switched telephone network (PSTN). Typically these lines are supplied in bundles of 25 twisted-pair conductors per bundle. There may be greater or fewer twisted-pair conductors per bundle. For example, a typical DSLAM may supply DSL service at VDSL data rates to 25 DSL modems located at the customer end. VDSL data rates are up to 26 Mbps (Megabits per seconds) upstream and downstream. Other forms of DSL service having different data rates may also be supplied such as ADSL (up to 1.5 Mbps upstream, 8Mbps downstream), SHDSL (up to 4 Mbps upstream and downstream), and BDSL (1.5 Mbps upstream and downstream).

Amend the paragraph beginning at Page 2, line 18 as follows:

By way of introduction, the preferred embodiments below provide a method and system for oversubscribing a DSL modem. The system is installed between at least one upstream data link and a plurality of downstream data links. Each downstream data link is coupled to a respective ~~Customer Premise Equipment Device~~ customer premise equipment device. The system comprises M DSL modems connected to the at least one upstream data link, P OAM/EOC modems in communication with the M DSL modems, and a switch, or multiplexer, connected to the N downstream data links. The switch connects the M DSL modems and the P OAM/EOC modems to the N downstream data links thereby allowing communication between the DSL and P OAM/EOC modems and

the ~~Customer Premise Equipment~~ customer premise equipment devices. Various embodiments of the system comprising analog multiplexers, digital multiplexers, and Time Division Multiplexed switches are disclosed.

Amend the paragraph beginning at Page 3, line 1 as follows:

The M DSL modems are connected to a first set of M ~~Customer Premise Equipment~~ customer premise equipment devices, and the P OAM/EOC modems are connected to a first set of P ~~Customer Premise Equipment~~ customer premise equipment devices. User traffic data is transferred between the M DSL modems and the first set of M ~~Customer Premise Equipment~~ customer premise equipment devices. Synchronization data is transferred between the P OAM/EOC modems and the first set of P ~~Customer Premise Equipment~~ customer premise equipment devices. In response to requests to send and receive data the M DSL modems are connected to a second set of M ~~Customer Premise Equipment~~ customer premise equipment devices, and the P OAM/EOC modems are connected to a second set of P ~~Customer Premise Equipment~~ customer premise equipment devices. Requests to send and receive data are embedded within superframes. User traffic data and synchronization data is transferred between the modems and the second sets of ~~Customer Premise Equipment~~ customer premise equipment devices. The first and second sets of ~~Customer Premise Equipment~~ customer premise equipment devices are selected such that at least some ~~Customer Premise Equipment~~ customer premise equipment devices that did not receive DSL service as part of the first set receive DSL service as part of the second set.

Amend the paragraph beginning at Page 4, line 14 as follows:

Fig. 2 illustrates a preferred embodiment of a system for oversubscribing a DSL modem. The DSL modem switching system 20 comprises a switch 230, M DSL ~~Modems~~ modems 210, and P OAM/EOC (Operation Administration Maintenance/Embedded Operations Channel) ~~Modems~~ modems 220. The switching system 20 is connected between at least one upstream data link 22 and a plurality of N downstream data links 24. Each downstream data link is coupled to respective ~~Customer Premise Equipment~~ customer premise equipment devices 240. The upstream data links 22 may comprise, for example, a POTS line, optical fiber, a twisted pair conductor, the ~~Public Switched Telephone Network~~ public switched telephone network, a T1 connection, a T3 connection, an ISDN connection, coaxial cable, an SHDSL link, an ADSL link, a VDSL link, an HDSL link, a V.90 link, an OCn link, and the like. The downstream data links 24 preferably comprise POTS lines, but may also include coaxial cable. The terms "POTS lines" and "twisted pair conductors" are used interchangeably.

Amend the paragraph beginning at Page 4, line 26 as follows:

The M DSL ~~Modems~~ modems 210 provide DSL service, including the transfer of user traffic data, between the upstream data links 22 and M of the N ~~Customer Premise Equipment~~ customer premise equipment devices 240 via the downstream data links 24. User traffic data includes e-mail, software downloads and updates, web pages, audio and video files, data for maintaining a user's computer on a network, and the like. The P

OAM/EOC ~~Modems~~ modems maintain active DSL lines by communicating synchronization data to P of the N ~~Customer Premise Equipment~~ customer premise equipment devices 240 via the downstream data links 24. The terms" active DSL lines" and "synchronized DSL lines" are intended broadly to mean that a link and a CPE device connected to the link remains in a state as if the link and CPE device were connected to a DSL modem.

Amend the paragraph beginning at Page 5, line 16 as follows:

Typically both the user traffic data and the synchronization data are communicated via superframes. Superframes are defined in standards ANSI 71.413-1998 and ITU G.992.2, both of which are hereby incorporated by reference. The superframes communicated by the P OAM/EOC modems carry very little user traffic data and thus have bandwidth requirements only a fraction of that of superframes communicated by the M DSL ~~Modems~~ modems.

Amend the paragraph beginning at Page 6, line 1 as follows:

The Switch 230 connects the M DSL ~~Modems~~ modems 210 and the P OAM/EOC ~~Modems~~ modems 220 to respective ~~Customer Premise Equipment~~ customer premise equipment devices 240 via the downstream data links 24. The switch 230 is reconfigured in response to requests to send and receive user traffic data to and from the N ~~Customer Premise Equipment~~ customer premise equipment devices 240, thus providing DSL

service to a set of M ~~Customer Premise Equipment~~ customer premise equipment devices and maintaining active DSL lines to the remaining P ~~Customer Premise Equipment~~ customer premise equipment devices.

Amend the paragraph beginning at Page 6, line 7 as follows:

Requests to send and receive user traffic data are communicated between the DSL ~~Modems~~ modems 210, the OAM/EOC ~~Modems~~ modems 220, and the ~~Customer Premise Equipment~~ customer premise equipment devices 240 via Request-to-Send (RTS) and Clear-to-Send (CTS) signals. Preferably, the RTS/CTS signals are embedded within superframes. RTS and CTS signals are discussed in detail in US Patent Application "System for Enhancing Data Transfer", Inventor Michael Farmwald, Filing Date 09/13/2001, ~~Application Number 09/951,351~~ U.S. Patent No. 6,798,769 B1, which is hereby incorporated by reference.

Amend the paragraph beginning at Page 7, line 20 as follows:

The switch 230 can be implemented in the analog or digital domain and is preferably capable of connecting any of the M DSL ~~Modems~~ modems 210 and P OAM/EOC ~~Modems~~ modems 220 to any of the N ~~Customer Premise Equipment~~ customer premise equipment devices 240 via the downstream data links 24. It is well understood by those skilled in the art how to construct such switches and many actual physical implementation of the switch, as well as of the other components of the DSL

modem switching system 20, can be used while remaining within the scope and nature of the inventions disclosed herein.

Amend the paragraph beginning at Page 7, line 27 as follows:

The switch 230 is controlled by the DSL ~~Modems~~ modems 210 and the OAM/E0C ~~Modems~~ modems 220 to allow communications and maintain synchronization between the CPE devices 240 and the modems 210, 220. The OAM/E0C ~~Modems~~ modems and DSL ~~Modems~~ modems are also in communication with each other. The ~~Customer Premise Equipment~~ customer premise equipment, for example, comprises a plurality of DSL modems capable of forming and maintaining communications with the DSL ~~Modems~~ modems 210 and the OAM/EOC ~~Modems~~ modems 220.

Amend the paragraph beginning at Page 8, line 3 as follows:

Both the DSL ~~Modems~~ modems 210 and the OAM/EOC ~~Modems~~ modems 220 are preferably implemented in software on a DSP. Furthermore both the OAM/EOC ~~Modems~~ modems 220 and the DSL ~~Modems~~ modems 210 may be implemented on the same DSP and may include various filtering and control functions necessary for successful DSL communications.

Amend the paragraph beginning at Page 8, line 20 as follows:

N CPE devices are provided DSL service, including transferring user traffic data, from M DSL ~~Modems~~ modems, where M is less than N. For example 25 CPE devices may receive DSL service from 5 DSL modems. Varying numbers of DSL modems from 1 to 1-N may provide service to the N CPE devices.

Amend the paragraph beginning at Page 9, line 1 as follows:

Oversubscribing a DSL modems includes connecting M DSL modems to a first set of M CPE device and connecting P OAM/EOC modems to a first set of P ~~Customer Premise Equipment~~ customer premise equipment devices. That is, each DSL modem is connected to a CPE device and each OAM/EOC modem is connected to a CPE device. Once connected, user traffic data is transferred between the M DSL modems and the first set of M CPE device, and synchronization data is communicated between the P OAM/EOC modems and the first set of P CPE device.

Amend the paragraph beginning at Page 9, line 8 as follows:

User traffic data continues to flow between the M DSL modems and M CPE devices until either there is no more data to transmit and receive between each respective M DSL modem and M CPE device ~~No-More-Data~~ no-more-data condition), or until a time-out period has expired (~~Time-Out~~ time-out condition). Time-outs are necessary to prevent bandwidth greedy customers from monopolizing bandwidth. A greedy customer is allotted a fixed or varying amount of time during which the greedy customer can transmit and receive data. Once the time period has elapsed, the bandwidth allocated to

the greedy customer is made available to subsequent customers. The bandwidth may be reassigned back to the greedy customer after the subsequent customers either complete their data transactions or times-out. In this manner, high quality service is afforded to all customers during heavy network usage times.

Amend the paragraph beginning at Page 9, line 19 as follows:

Upon a ~~No-More-Data~~ no-more-data or ~~Time-Out~~ time-out event, the M DSL modems are connected to a second set of M CPE device, and the P OAM/EOC modems are connected to a second set of P CPE devices. At least some of the devices comprising the second set of M CPE devices are devices that were members of the first set of P CPE devices. In other words, at least some CPE devices that were not receiving DSL service as part of the first set are connected such as to enable DSL service as part of the second set. Equivalently, at least some of the second set of P CPE devices are members of the first set of M CPE devices thereby ensuring active DSL connections when DSL service is switched away from a device that was receiving service as part of the first set.

Amend the paragraph beginning at Page 9, line 28 as follows:

Once the switchover from the first set of connections to the second set of connections are completed, user traffic data is transferred between the M DSL modems and the second set of M CPE devices, and synchronization data is transferred between the P OAM/E0C modems and the second set of P CPE devices. It should be further noted

that if a ~~Time-Out~~ time-out or a ~~No-More-Data~~ no-more-data condition for an individual CPE device does not occur, those individual CPE devices of the first set may continue to receive uninterrupted DSL service, and thus become part of the second set of M CPE devices. Third, fourth, and additional sets of connections are made thereby allowing all CPE devices to receive DSL service.

Amend the paragraph beginning at Page 10, line 7 as follows:

Request to send and receive data, such as RTS/CTS signals, are transferred between the N CPE devices and the DSL and ~~OAM/EoC Modems~~ OAM/EOC modems. The requests are preferably embedded within superframes. In accordance with the requests, connections between the modems and the first, second, and subsequent sets of CPE devices are made.

Amend the paragraph beginning at Page 10, line 11 as follows:

Since there are less DSL ~~Modems~~ modems than there are CPE devices there will occasionally be more requests for DSL service than there are DSL ~~Modems~~ modems available to provide service. In establishing which CPE devices to provide DSL service, a First Come First Served method is employed. That is, the CPE devices first to request service will be first to receive service. It is also advantageous to be able to employ priority queuing schemes so that, for example, those customers paying more for DSL service receive more access to the available bandwidth. That is, their requests for service

take precedence over those requests having a lower priority. An algorithm suitable for queuing multiple requests of varying priorities is Weighted Fair Queuing. Other algorithms well understood by those skilled in the art may be used. Additionally, the priorities may be associated with the ~~Time-Out~~ time-out conditions introduced above so that customers with a higher priority will have longer time-out periods than those with a lower priority.

Amend the paragraph beginning at Page 10, line 23 as follows:

Thus oversubscribing a DSL modem comprises the following steps:

1. According to priority and order of request, connect each CPE device to either a DSL ~~Modem~~ modem or an OAM/E0C ~~Modem~~ modem;

2. For each CPE device, if connected to a DSL ~~Modem~~ modem, transfer user traffic data; otherwise if connected to an OAM/E0C ~~Modem~~ modem, transfer synchronization data;

3. For each CPE device connected to a DSL ~~Modem~~ modem, check for ~~Time-Out~~ time-out or ~~No-More-Data~~ no-more-data condition;

    a. if condition does not exist go to step 2.

    b. if condition does exist go to step 1.

Amend the paragraph beginning at Page 11, line 3 as follows:

Step 1 can employ a First Come First Served algorithm, a Weighted Fair Queuing

algorithm, or any other algorithm for request handling available to those skilled in the art. Requests for DSL service are communicated via OAM/EOC in-band RTS/CTS signals. Accordingly, synchronization data comprises a superframe, and the superframe comprises embedded RTS/CTS signals. The ~~Time-Out~~ time-out condition of Step 3 can employ a priority scheme whereby CPE devices having a higher priority have longer ~~Time-Out~~ time-out periods than those CPE devices with a lower priority. In transferring control from Step 3b to Step 1 some CPE devices connected to DSL ~~Modems~~ modems may retain their connections inasmuch as no ~~Time-Out~~ time-out or ~~No-More-Data~~ no-more-data condition has occurred for those devices. In retaining their connections, the devices continue to receive uninterrupted DSL service. Simultaneously, other CPE devices connected to DSL ~~Modems~~ modems may be reconnected to OAM/EOC modems.

Amend the paragraph beginning at Page 11, line 19 as follows:

Fig. 5A shows DSL ~~Modem~~ modem1 providing DSL service to CPE Device 1. OAM/EOC ~~Modems~~ modems 1, 2 and 3 provide synchronization data to CPE Device 2, 3 and 4 respectively, for maintaining active DSL lines. Through a ~~Time-Out~~ time-out or a ~~No-More-Data~~ no-more-data condition, DSL service is removed from CPE Device 1 and provided to CPE Device 3, as shown in Fig. 5B. CPE Device 3 receives DSL service ahead of the other CPE devices because at least one of the following conditions occur: CPE Device 3 was the first to request service, CPE Device 3 was the highest priority device to request service, or CPE Device 3 was the only device to request service. Additionally, OAM/EOC ~~Modem~~ modem 2 is connected to CPE Device 1 to maintain an

active DSL line. The other OAM/EOC ~~Modems~~ modems remain connected to respective CPE Devices for maintaining synchronization. In Fig. 5C, after a ~~Time-Out~~ time-out or a ~~No-More-Data~~ no-more-data condition, DSL service is removed from CPE Device 3 and provided to CPE Device 2. In order to maintain an active DSL line a connection ~~in~~ is made between OAM/EOC ~~Modem~~ modem 1 and CPE Device 3.

Amend the paragraph beginning at Page 13, line 29 as follows:

Fig. 8 shows another alternative analog implementation of a system for oversubscribing a DSL modem. The DSL modem switching system 80 comprises N isolation circuitry 800 coupled to N CPE devices 842 via downstream data links 840. The isolation circuitry in turn is coupled to N 2to4 Hybrids with Line Drivers 802 which in turn is coupled to an M:N analog multiplexer 806 and a P:N analog multiplexer 808. A DSL DSP path 82 is in communication with the M:N analog multiplexer 806 and at least one upstream data link 86. The DSL DSP path 82 comprises M High Frequency Digitizers 810 coupled to the M:N analog multiplexer 806, and M DSL DSPs 812 coupled to the M High Frequency Digitizers 810 and the at least one upstream data link 86. Similarly an OAM/EOC path comprises P OAM/EOC ~~Modems~~ modems 816, and P Low Frequency Digitizers 814 coupled to the P:N multiplexer 808 and with the P OAM/EOC DSPs 816.

Amend the paragraph beginning at Page 14, line 25 as follows:

Fig. 9 show a digital implementation of a system for oversubscribing a DSL ~~Modem~~ modem. DSL switching system 90 comprises N Isolation Circuitry 900 in communication with N CPE devices 942 via downstream data links 940, N 2to4 Hybrids with Line Drivers 902 in communication with the N Isolation Circuitry 900, N High Frequency Digitizers 904 in communication with the N 2to4 Hybrids with Line Drivers 902, and an M:N digital multiplexer 906 and a P:N digital multiplexer 908 each in communication with the N High Frequency Digitizer 904. A DSL DSP path 92 is in communication with the M:N digital multiplexer 906 and with at least one upstream data link 96. The DSL DSP path 92 comprises M DSL DSP modems 910 connected to the at least one upstream data link 96 and the M:N digital multiplexer 906. An OAM/EOC DSP path 94 is in communication with the P:N digital multiplexer 908. The OAM/E0C DSP path 94 comprises P OAM/E0C DSPs 912 in communication with the P:N digital multiplexer 908. As in the previous embodiments the relationship between the ports of the M:N and P:N digital multiplexers 906, 908 respectively is M+P=N, P≥1.